BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to electrical condensate overflow safety switches and, more particularly, to a float actuated magnetic reed switch attachable to the condensate drainage system of an air-cooling system for deactivating the system upon the level of condensate in the condensate drainage system reaching a predetermined level, thereby preventing collected liquid condensate from overflowing the condensate drainage system.

Discussion of the Related Art

Most residential and commercial air-conditioning and refrigeration units employ an evaporator coil to dehumidify and cool ambient air in dwellings, climate controlled storage spaces, work spaces, and the like. The evaporator coil is frequently located indoors, often above the occupied areas of the building that it serves. Since the coil is colder than the air being conditioned, it condenses water liquid while in operation. This condensate liquid is typically collected in a drain pan, usually positioned under the coil, with the drain pan having one or more outlet ports for attaching a drain pipe for outflow of the condensate. Many units have a secondary drain pan which may not have any outlets or connecting drain pipes. During normal operation, the condensate water liquid drains through one or more of

the outlets of the main drain pan, through a drain pipe and out from the building. However, the drain pan, pan outlets and drain pipe, often become occluded by algae, mold, mildew, dirt and other accumulated debris. An occlusion in the outlets and/or drain pipes will eventually result in drain pan overflows that can cause water damage to building ceilings, walls, flooring, and associated building components, which necessitate costly repairs. In units which use a secondary drain pan, the liquid condensate will first overflow into the secondary drain pan. In some instances, the secondary drain pan will overflow and cause water damage.

Summary of the Invention

The present invention is directed to an overflow safety switch for attachment to the condensate drainage system of an air-cooling system in order to prevent overflow of condensate which collects in the condensate drainage system. In accordance with various embodiments of the invention, the overflow safety switch may be attached to one of the vertical side walls of the drain pan or through the bottom of the drain pan or drain pipe. In one embodiment, a brace attaches to the side wall of the drain pan and holds the overflow safety switch in a vertical upright position within the drain pan. In another embodiment, the overflow safety switch is mounted through the side wall and maintained in a generally horizontal position. In yet another embodiment, the overflow safety switch is mounted through the bottom of the drain pan so that the safety switch is held vertically upright within

the drain pan. In still a further embodiment, the overflow safety switch is connected to a drain pipe or drain outlet extending from the drain pan.

In each embodiment, the overflow safety switch is electrically connected to either a circuit of the air-cooling system, a power circuit or an alarm circuit. The overflow safety switch includes a tube which extends within any water conducting area of condensate drainage system. A reed switch is sealed within the tube and a float containing a magnet is moveably supported on the exterior of the tube. The float ascends or descends in response to the level of the liquid condensate within the condensate drainage system. As the float moves relative to the tube, the magnet causes the reed switch to open or close, thereby interrupting operation of the air-cooling system and/or actuating the alarm circuit. In yet a further embodiment, a normally open reed switch is connected to an alarm circuit, wherein movement of the float and magnet, in response to a rise in liquid in the drain pan, results in closing of the switch and activation of the alarm circuit.

Objects and Advantages of the Invention:

With the forgoing in mind, it is a primary object of the present invention to provide a condensate overflow safety switch for quick and easy attachment to the condensate drainage system of an air-cooling system, and wherein the overflow safety switch is structured and disposed to interrupt operation of the air-cooling system and/or activate an alarm upon the condensate liquid reaching a predetermined level at any point in the condensate drainage system, thereby preventing the condensate from overflowing the drain pan.

It is a further object of the present invention to provide an overflow safety switch characterized by simple mechanical and electrical design, compactness, non-corrosive, low manufacturing complexity, water sealed design and high operational reliability.

It is still a further object of the present invention to provide a condensate overflow safety switch which is structured and disposed for easy and quick attachment to the condensate drainage system of an air-cooling system, and wherein the overflow safety switch is structured and disposed to stop generation of condensate liquid in the event of a drain system occlusion, thereby preventing collected condensate liquid from overflowing the condensate drainage system which might otherwise result in property damage.

These and other objects and advantages of the present invention are more readily apparent with referenced to the detailed description and accompanying drawings.

Brief Description of the Drawings

For a fuller understanding of the nature of the present invention, reference should be made to the following detailed description taken in conjunction with the accompanying drawings in which:

Figure 1 is a top perspective view of a condensate overflow safety switch and mounting bracket for attaching the safety switch to the side wall of a drain

pan in an air-cooling system, in accordance with one preferred embodiment of the present invention;

Figure 2 is a cross-sectional view taken from the line indicated as 2-2 in figure 1;

Figure 3 is a perspective view, shown in cutaway, illustrating a condensate overflow safety switch mounted through the side wall of a drain pan in an air-cooling system, in accordance with a second preferred embodiment of the present invention;

Figure 4 is a cross-sectional view taken along the line indicated as 4-4 in figure 3;

Figures 5 and 6 are side elevation views, shown in partial cross-section, showing the overflow safety switch of figure 1 mounted to the side wall of a drain pan and illustrating a sequence of operation of the overflow safety switch between a low condensate level condition, wherein the overflow safety switch is in an normally closed circuit condition, and a raised condensate liquid level, wherein the overflow safety switch is in an open circuit condition to deactivate the air-cooling system;

Figures 7 and 8 are side elevational views, shown in partial cross-section, showing the overflow safety switch of figure 3 mounted to the side wall of a drain pan and illustrating a sequence of operation of the overflow safety switch between a low condensate level condition, wherein the overflow safety switch is in a normally closed circuit condition, and a raised condensate liquid

level, wherein the overflow safety switch is in an open circuit condition to deactivate the air-cooling system;

Figures 9 and 10 are side elevational views, shown in partial cross-section, showing the overflow safety switch mounted through the bottom of the drain pan, in accordance with yet another embodiment of the invention, and illustrating a sequence of operation of the overflow safety switch between a low condensate level condition, wherein the overflow safety switch is in a normally closed circuit condition, and a raised condensate liquid level, wherein the overflow safety switch is in an open circuit condition to deactivate the air-cooling system; and

Figures 11 and 12 are side elevational views, shown in partial cross-section, showing the overflow safety switch mounted within a drain pipe leading from the drain pan of a condensate drainage system and illustrating a sequence of operation of the overflow safety switch between a low condensate level condition, wherein the overflow safety switch is in a normally closed circuit condition, and a raised condensate liquid level, wherein the overflow safety switch is an open circuit condition to deactivate the air cooling system.

Like reference numerals refer to like parts throughout the several views of the drawings.

Detailed Description of the Preferred Embodiments

In each of the preferred embodiments, as shown throughout the drawings, the overflow safety switch assembly is generally indicated as 10 and includes a hollow tube 12 having an open end portion 14 and a closed end portion 16 with an outer surface 18 extending therebetween. A reed switch 20 has overlapping electrical contacts 22 connected to insulated wires 30. The contacts 22 of the reed switch 20 and the exposed ends of the wires 30 are maintained within the hollow tube 12. A sealing material 32, for example plastic or epoxy, insulates the reed switch 20 and exposed ends of the wires 30 within the hollow tube 12, thereby preventing contact with moisture. A portion of the outer surface 18 may be provided with threads 28 to facilitate attachment of the switch assembly to either a mounting clip 60, as shown in figures 1 and 2, or directly to the drain pan 100 of an air-cooling system, as seen in figures 3-4 and 7-10. The threads 28 on the outer surface 18 of the hollow tube serve to permit adjustable positioning of the hollow tube relative to the drain pan 100, as described more fully hereinafter. The overflow safety switch assembly may also be connected in-line to the drain pipe extending from the drain pan.

Referring now to the embodiment shown in figures 1-2 and 5-6, the overflow switch assembly 10 is provided with a float body 40 having a first end face 42 and a second end face 44. A removable stopper mechanism 38, such as a C-clip, is engaged onto the outer surface 28 of the hollow tube 12, adjacent the closed end portion 16. The float body 40 is captivated on the hollow tube 12, between the end

portions 14, 16 and is slidably moveable between the stopper mechanism 38 and an upper shoulder 48 defined by a fixed hex nut configuration integrally formed or adjustably moveable on the hollow tube. The float body 40 is moveable between a lowered position, as seen in figures 2 and 5, and a raised position, as seen in figure 6, in response to a raising condensate liquid level within the drain pan. The float body 40 is provided with a magnet 50 which may be exposed on the inner diameter of the float body. The magnet 50 is positioned in confronting relation to the outer surface 18 of the hollow tube and is disposed closer to the first end face 42 then the second end face 44 of the float body 40. When the wires of the reed switch are connected to a circuit of the air-cooling system, the float body 40 is mounted with the first end face 42 facing toward the stopper mechanism 38 near the end portion 16. When the wires are connected to an alarm circuit, the float body is mounted with the second end face 44 facing toward the stopper mechanism 38. In the embodiment shown in figures 1-2 and 5-6, the wires are connected to the circuit of the air-cooling system. In this instance, the contact elements 22 of the reed switch 20 are normally closed, maintaining a closed circuit condition, with the float body 40 at the lowered position, as seen in figures 2 and 5. As the condensate liquid fluid level rises within the drain pan 100, the float body 40 moves upwardly along the hollow tube 12. Eventually, the magnet 50 is moved into position to cause the contact elements 22 of the reed switch 20 to separate, as shown by the float body position in figure 6, thereby opening the circuit and disabling the air-cooling system. Accordingly, when the condensate fluid level reaches a predetermined

height in the drain pan 100, as seen in figure 6, the reed switch 20 is opened to disable the air-cooling system and prevent further production of condensate liquid until the occlusion, blockage or other drainage problem is fixed.

As seen in figures 1-2 and 5-6, the overflow switch assembly 10 is supported vertically in the drain pan 100 so that the lower closed end portion 16 extends downwardly within the drain pan, with the closed end positioned in close spaced relation to the bottom surface of the drain pan. A clip 60 is used in this particular embodiment for supporting the overflow switch assembly 10 in this position. In a preferred embodiment, the clip 60 is formed from a single piece of material, such as a metal alloy, and includes a horizontal plate 62, a vertical plate 64 and an inverted U-shaped portion 66 between the horizontal and vertical plates. The inverted U-shaped portion 66 is specifically structured and disposed to slip easily over the top edge of the drain pan and hold securely, as seen in figures 5 and 6. Tabs 68 are provided on the vertical plate for frictional engagement against the outer surface of the drain pan side wall, thereby holding the clip 60 in place on the drain pan 100. A screw 70 may be used for tightly securing the clip 60 onto the drain pan. Once the clip is attached to the drain pan, the position of the overflow switch assembly relative to the bottom of the drain pan may be adjusted by threadably advancing the hollow tube 12 relative to the horizontal plate 62 of the clip 60. To this end, it should be noted that, in a preferred embodiment, a through hole is formed through the horizontal plate 62 of the clip and is specifically sized and configured for

threadable engagement with the exterior threads 28 on the outer surface 18 of the tube 12.

Referring to the embodiment shown in figures 3-4 and 7-8, a float body 40' is supported on the hollow tube 12 between the stopper mechanism 38 on the closed end portion 16 and the shoulder 48. In this particular embodiment, the hollow tube 12 is mounted horizontally through the side wall of the drain pan 100 and the annular float body 40' is provided with an elongate rectangular passage 41 extending between the first end face 42' and the opposite second end face 44'. A magnet 50' is embedded within a lower portion of the float body and is normally spaced from the outer surface 18 of the hollow tube, as seen in figure 4, a sufficient distance so that there is no magnetic influence exerted on the elements 22 on the reed switch 20 within the hollow tube 12. As the condensate liquid level rises within a drain pan 100, the float 40' naturally rises relative to the hollow tube 12, eventually reaching the position shown in figure 8. At this position, the magnet 50' within the lower portion of the float body 40' is moved close to the outer surface 18 of the hollow tube 12, resulting in a magnetic attraction between the magnet 50' and reed switch 20, and causing the elements 22 of the reed switch to separate, thereby opening the circuit and disabling the air-cooling system. As seen in figure 4, a rubber O-ring seal 80 or washer is fitted about the outer surface 18, at the threaded portion 28 of the hollow tube, and is placed against the outer surface of the side wall of the drain pan 100, surrounding a through hole drilled through the drain pan. This seal 80 is held tight against the outer surface of the drain pan with a nut

82 or other fastening device which further serves to secure the switch assembly 10 in the horizontal position and attached to the side wall of the drain pan. The seal 80, when tightly sandwiched between the nut 82 and outer surface of the drain pan side wall prevents leakage through the hole in the side wall of the drain pan.

Referring to figures 9 and 10, a further embodiment of the overflow switch assembly 10 is shown. In this particular embodiment, the structure of the switch assembly 10 is similar to that shown in connection with the embodiment of figures 1-2. In the embodiment shown in figure 9 and 10, the hollow tube 12 and the reed switch 20 are mounted upwardly through the bottom of the drain pan so that the closed end portion 16 is spaced sufficiently above the inner bottom surface of the drain pan. To secure the overflow safety switch 60 to the drain pan 100, a hole may be drilled through the bottom of the drain pan. The hole may be sized and configured for threadable, advanced passage of the threaded end portion of the hollow tube. Once securing and adjusting the hollow tube 12 at the desired height within the drain pan, a seal 80 may be placed around the hole in the bottom of the drain pan through which the hollow tube extends. Similar to the embodiment of figures 1-2, the float 40 includes a magnet 50 which moves with the float body in relation to the outer surface 18 of the hollow tube 12 and the reed switch 20 therein. In the position shown in figure 9, the annular float body 40 is in lowered position, due to a low condensate liquid level in the drain pan 100. As the condensate liquid level rises, the annular float body 40 moves upwardly along the hollow tube 12 causing the magnet 50 within the float body to separate. This results in opening

the circuit and disabling the air-cooling system so that no further condensation is produced until the blockage or other drainage problem is fixed.

Referring to Figures 11 and 12, the overflow switch assembly 10 is shown in yet a further embodiment wherein the switch assembly 10 is fitted to a pipe 120 with the hollow tube 12 extending through the pipe so that the upper shoulder 48, closed end portion 16 and float body 40 are positioned within the pipe. As seen in Figures 11 and 12, the hollow tube 12 is fixed to the pipe 120 so that the outer surface 18 between the upper shoulder 48 and stopper mechanism 38 is vertically positioned, thereby permitting movement of the float body 40 between a lowered position and a raised position as the fluid liquid level in the pipe changes. Figure 11 illustrates a normal condition, wherein fluid is flowing freely and unobstructed through the pipe 120. In this instance, the fluid level remains low with the float body 40 at the lowered position, thereby maintaining the overflow safety switch in a normally closed circuit condition. In the event the liquid level rises within the pipe 120, due to a clog or other obstruction, the float body 40 rises, as seen in Figure 12, to operate the overflow safety switch to the open circuit condition, thereby interrupting electric current flow through conductors 30. The installation of the overflow safety switch in the manner shown in Figures 11 and 12 is particularly useful in drain pipes of an air cooling system. In this instance, the overflow safety switch 10 is fitted in-line to the drain pipe leading from a drain pan of the air cooling system's drain system. In the event of a down line clog or other obstruction in the drain pipe 120, the liquid level will rise in the pipe, as shown in Figure 12.

When the float body moves up to the raised position seen in Figure 12, the circuit is opened and the air cooling system is disabled so that no further condensation is produced until the blockage in the drain pipe is removed. Accordingly, in the event of a blockage or other drainage problem, the air cooling system will be disabled with little or no liquid accumulation in the drain pan.

While the instant invention has been shown and described in accordance with preferred and practical embodiments thereof, it is recognized that departures from the instant disclosure are contemplated within the spirit and scope of the present invention.